

Sediment Characterization Report

North Park Lake Aquatic Ecosystem Restoration Project

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**North Park Lake Sediment Characterization
Allegheny County, PA
Executive Summary**

Altech Environmental Services, Inc. (Altech) prepared this Sediment Characterization Report for the US Army Corps of Engineers (USACE), Pittsburgh District (CELRP). The purpose of the report is to support a CELRP Feasibility Study for an Aquatic Ecosystem Restoration Project to remove accumulated sediment from North Park Lake and Marshall Lake, in McCandless Township, Allegheny County, Pennsylvania. Dredging specific portions of each lake is intended to significantly decrease the amount of accumulated sediment, thus expanding the quantity and improving the quality of aquatic habitat in the lakes.

North Park Lake is 75 acres in size, and as shown in the figures, the North Park Dam is situated just below the confluence of North Fork Pine Creek (which flows from the north), and Pine Creek (which flows from the west). The North Park Lake water surface level is controlled by a fixed weir located at the dam at an elevation 960 feet above Mean Sea Level (MSL). Marshall Lake, which is much smaller, is located about a mile and a half upstream of the North Park Lake Dam on the North Fork Pine Creek. A fixed weir at elevation 989 MSL controls the water level in Marshall Lake.

The purpose of the CELRP Feasibility Study is to characterize project site conditions, develop viable remedial alternatives and relative costs, propose an optimum plan, and provide a programming level cost estimate and schedule for completion of design and construction.

Remedial action alternatives currently being considered include:

- Dredging North Park Lake and repair or replacement of the outlet works at the Marshall Lake Dam;
- Complete draining and excavating lake sediments in the dry;
- Hydraulic dredging of the lake; and
- Partial draining and a combination of dredging and dry excavation.

Each of these options will require the removal and placement of a large volume of accumulated sediments. The work performed by Altech was designed to accomplish a combination of geotechnical and chemical data acquisition to support the Feasibility Study objectives. However, the primary objective of the sediment characterization was to answer the following principal study question:

Is there any chemical contaminant in sediments to be dredged from Marshall Lake or North Park Lake present at a concentration that could pose a significant risk to human health or the environment if the dredged sediments are placed in an upland area within North Park?

To answer this question, sampling, analyses and regulatory protocol were specified in the project scope of work to measure the chemical content of the most likely potential contaminants to the parts per billion level in the subject sediments. The scope of work was

based on results of a CELRP request to the Pennsylvania Department for Environmental Protection (PaDEP) for review and comment on the North Park Lake project. The scope of work included a copy of the PaDEP Draft Dredging Guidelines as the primary basis for the sampling and analyses specified.

Because measured data is at best, an approximation of actual conditions, a detailed Sampling and Analysis Plan (SAP) was designed to control the variables that effect data precision, accuracy and representativeness to within prescribed levels. As specified in the scope of work, the SAP was also based on review of relevant and applicable regulations. This review indicated that the regulation of fill materials has been contentious in Pennsylvania, and that PaDEP is in the process of promulgating a new regulation based on its current "Safe Fill" policy. The final SAP was designed to answer the principal study question by resulting in the quantity and quality of data needed to properly characterize the chemical content of the sediments by direct comparison of the results to the PaDEP [Draft] Dredging Guidelines, Clean Fill, Safe Fill and Act 2 Medium Specific Concentration criteria.

In accord with the SAP, North Park lake was subdivided into eight hypothetical Management Units (MU-1 through MU-8), representing nearly equal volumes of sediment proposed to be dredged. Sediment proposed to be dredged in Marshall Lake was defined as one Management Unit, (MU-9). Four borings were scheduled in each MU for the collection of a variety of samples for geotechnical and chemical analyses. Samples for chemical analysis were subdivided into three categories, Primary, Secondary and Tertiary. All Primary Samples were to be composite samples comprised of representative portions of all four borings in the MU and were scheduled for analysis for the presence of Total Petroleum Hydrocarbons (TPH), Total Extractable Organic Halogens (EOX), Polychlorinated Biphenyls (PCBs), chlordane, total chlorides and Target Analyte List (TAL) metals.

The analysis of Secondary and Tertiary Samples was contingent upon the results of analysis of the Primary Samples. There were four Secondary Samples from each MU for potential analysis, each was a composite of the material from the total length of one of the four borings in the MU. The Tertiary Samples were for potential analysis of USEPA Target Compound List Volatile and/or Semi-Volatile Organic Compounds (VOCs and/or SVOCs) if high values of the indicator parameters TPH and/or EOX were detected.

All field sampling of sediment was accomplished from a floating plant between October 1 and October 11, 2002 in close compliance with the approved SAP. All chemical laboratory analyses were conducted by a USACE certified laboratory in accord with rigorous quality control requirements. Remarkably consistent geotechnical and chemical results were obtained.

The boring records appear to confirm that the major source of sediment load to North Park Lake has been Pine Creek. The thickness of very soft sediments (> 11 feet) was far greater in MU-1 through MU-5, (which encompass the Pine Creek Arm of the lake and the area adjacent to the dam), than in MU-6, MU-7 or MU-8, (which extend up the North Fork Arm of the lake). It appears that Marshall Lake has performed as a retention basin where sediment carried from upstream in the North Fork watershed has been retained, or that there has been far less soil disturbing development in the upstream North Fork Pine Creek watershed.

Ten Primary Samples were analyzed, one from each of the nine MUs (PS-1 through PS-9), plus one field duplicate from MU-5, labeled PS-10. There were no PCBs, chlordane or EOX detected in any of the ten samples, and none of the detected values of TPH, TAL Metals or Chloride indicated the presence of any chemical contaminants at a highly toxic concentration. However, TPH concentrations detected in PS-1, PS-3 and both samples from MU-5, PS-5 and PS-10 exceeded the "Unrestricted Use" criteria specified in the [Draft] Dredging Guideline of 120 mg/Kg. Lead concentrations detected in samples PS-3, PS-5 and PS-10 also exceeded the [Draft] Dredging Guideline for total lead of 45 mg/Kg.

The four Secondary Samples from MU-3 and eight from MU-5 were subsequently analyzed for both TPH and lead, and the four Secondary Samples from MU-1 were analyzed for TPH. Following the [Draft] Dredging Guideline procedure, the mean concentration for the Primary and four Secondary Sample results from each MU was then calculated and substituted into the original data set for the initial primary Sample value to establish a mean and upper confidence level for the mean concentration of TPH and lead found in the subject sediment. For instance, the mean concentration value of the PS-1, SS-1a, SS-1b, SS-1c and SS-1d results for TPH was substituted into the original set of Primary Sample results for the PS-1 value.

Following this procedure, the mean value of TPH in the combined North Park Lake and Marshall Lake samples was calculated to be 59 mg/Kg, and the 95% upper confidence level for the mean concentration was 95 mg/Kg, well below the "Unrestricted Use" criteria. For North Park Lake alone, the mean TPH value was 63.5 mg/Kg and the 95% upper confidence level value was 104 mg/Kg, still well below the applicable "Unrestricted Use" criteria of 120 mg/Kg.

The mean value of lead in the combined North Park Lake and Marshall Lake samples was calculated to be 36.6 mg/Kg, and the 95% upper confidence level for the mean concentration was 49.3 mg/Kg, above the "Unrestricted Use" criteria of 45 mg/Kg. For North Park Lake alone, the mean lead value was 38.2 mg/Kg and the 95% upper confidence level value was 52.7 mg/Kg, again above the applicable criteria. While the lead data reflects levels that may be above naturally occurring lead levels, the results do not indicate significant contamination. The table of, "Trace Chemical Element Content of Natural Soils," published by the USEPA OSWER in 1983 indicates the common range of lead concentrations in soil is 2 mg/Kg to 200 mg/Kg, with an average value of 10 mg/Kg. The numerical standard proposed in the Safe Fill policy is 450 mg/Kg, 8-10 times higher than 95% upper confidence level values calculated for the mean concentration of lead in the subject sediments.

The chemical analyses results corresponded to the boring observations and geotechnical laboratory results, indicating that albeit low, nearly each measured level of each target chemical was consistently higher in MU-1 through MU-5 samples, than in MU-6 through MU-8 or MU-9 samples. The results of the sediment characterization provide defensible quantitative data to indicate that if dredged sediments from North Park Lake or Marshall Lake are placed in upland areas of the park for landscaping or recreational purposes, the in-place sediments will pose no significant risk to human health or the environment.



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1.0 Introduction

This Sediment Characterization Report was prepared by Altech Environmental Services, Inc. (Altech) for the US Army Corps of Engineers (USACE), Pittsburgh District (CELRP). The purpose of the report is to support a CELRP Feasibility Study for an Aquatic Ecosystem Restoration Project to remove accumulated sediment from North Park Lake and Marshall Lake, in McCandless Township, Allegheny County, Pennsylvania. The project required acquisition of representative samples of sediment from areas of excess accumulation for field and laboratory analyses to determine geotechnical properties and to identify and quantify chemical contamination, if present. All work was conducted in accordance with the approved Project Work Plan (PWP), which included a Quality Control Plan (QCP), a Sampling and Analysis Plan (SAP), and a Site Safety and Health Plan (SSHP).

Relevant background information and the project objectives are described in the Introduction. Section 2 summarizes the technical project planning process conducted by CELRP and Altech to define the number, location and methods of procuring field samples and the respective laboratory analysis parameters for each sample. Section 3 describes the results of the field sampling activities. Section 4 is a discussion of the results of analyses and statistical calculations conducted to evaluate all the analytes detected in sediment samples relative to applicable Pennsylvania Department of Environmental Protection (PaDEP) criteria. Boring locations are depicted in the Figures Section, and the Tables Section depicts the raw data for all analytes detected and descriptive statistical calculation results used to further characterize the data.

Appendix A contains the complete set of boring records and geotechnical laboratory test results. Appendix B presents a comprehensive set of summary tables of the chemical analyses of field and QC samples and the results of the Altech Quality Assessment performed prior to incorporating data for use in the report. Appendix C provides a copy of the QA comments and responses to the draft report, and Appendix D is a copy of the complete laboratory data report provided by the Pittsburgh facility of Severn Trent Laboratories, (STL).

1.1 Project Information

The CELRP is developing an Aquatic Ecosystem Restoration Project pursuant to Section 206 of the Water Resources Development Act of 1996 (WRA 1996), Public Law 104-303 at two man-made lakes, North Park Lake and Marshall Lake, located in McCandless Township, Allegheny County, Pennsylvania. Dredging specific portions of each lake is intended to significantly decrease the amount of accumulated sediment in the lakes, thus expanding the quantity and improving the quality of aquatic habitat in the two lakes.

Figure 1 is a Project Location Map to locate North Park Lake and Marshall Lake relative to Pittsburgh, PA. Figure 2, the Project Vicinity Map, depicts the general limits of the two lakes and the community park property upstream of the lakes. North Park Lake is 75 acres in size, and as shown, the North Park Dam is situated just below the confluence of North Fork Pine Creek (which flows from the north), and Pine Creek (which flows from the west). The North Park Lake water surface level is controlled by a fixed weir located at the dam at elevation

960 Mean Sea Level (MSL). Marshall Lake, which is much smaller, is located about a mile and a half upstream of the North Park Lake Dam on the North Fork Pine Creek. A fixed weir at an elevation of 989 feet above MSL controls the water level in Marshall Lake.

The purpose of the feasibility study is to characterize project site conditions, develop viable remedial alternatives and relative costs, propose an optimum plan and provide a programming level cost estimate and schedule for completion of design and construction. Alternatives currently being considered include:

- Dredging North Park Lake and repair or replacement of the outlet works at the Marshall Lake Dam;
- Complete draining and excavating lake sediments in the dry;
- Hydraulic dredging of the lake; and
- Partial draining and a combination of dredging and dry excavation.

Each of these options will require the removal and placement of a large volume of accumulated sediments. The intent is to reuse the sediment excavated for the project as fill for recreation and landscape purposes at various locations within the park.

1.2 Site Conditions and History

Both of the subject lakes are man-made and well within the boundaries of a community park. Nearly all land adjacent to both lakes is forested or otherwise covered by vegetation. However, once located in a relatively remote rural area north of Pittsburgh, the area surrounding the park and the upstream watershed has experienced significant suburban development. Both lakes have begun to fill with sediment, decreasing the surface area and volume of both lakes. The CELRP prepared a Preliminary Restoration Plan (PRP) for this project, which provided a reconnaissance level assessment of the sedimentation problem and viable alternatives to increase the volume and quality of aquatic habitat in the lakes. The PRP concluded that there was a significant opportunity to improve aquatic habitat in both North Park Lake and Marshall Lake through a controlled dredging program, and that the benefits would be commensurate with the costs and consistent with the National Ecosystem Restoration (NER) plan.

Recent sediment accumulation has been most extensive in the Pine Creek Arm of the lake. Much of the Pine Creek watershed is located outside the boundaries of the park, and suburbanization in these upstream areas has altered the hydrology. Forested land has been cleared and replaced with pavements, rooftops and mowed lawns. These type changes reduce the amount of rainfall that infiltrates into the ground and promote much more rapid runoff, which creates higher peak flow rates and velocities in the stream. High flow rates scour the stream banks upstream in the watershed and transport suspended sediments downstream. As the free flowing Pine Creek approaches the North Park Lake impoundment, velocities begin to decrease rapidly. This sudden drop in velocity allows suspended sediments time to settle and deposit from the water column. While this has reduced the area and volume of the lake, it has resulted in the formation of several acres of high quality wetland habitat at the head of the Pine Creek Arm of the North Park Lake.

1.3 Project Objective

The sediment sampling and chemical and geotechnical analyses for this project were conducted for multiple objectives. The geotechnical characterization and analyses were designed to provide sufficient data to base selection of viable sediment removal and placement alternatives. The field screening and laboratory chemical analyses of the sediments were designed to provide sufficient data to determine if the most likely common chemical contaminants are present at levels that could be toxic to human health and to provide a basis for selection of viable placement locations and methods.

The combined geotechnical and chemical sampling program had the following objectives:

- (1) Determine through quantitative laboratory analyses of representative samples if sediments proposed for dredging contain chemical contaminants at or above relevant PaDEP criteria, which include [Draft] Dredging Guidelines, Clean Fill and Safe Fill Numerical Standards and the Statewide Human Health Standards [Medium Specific Concentration (MSC)] values.
- (2) Determine the geotechnical properties of sediments from North Park and Marshall Lake.
- (3) Provide the CELRP and Allegheny County data of sufficient quantity and quality to demonstrate due diligence in their efforts to characterize the sediments to be removed and support objective evaluation/presentation of sediment placement options and selection of recommended dredging and sediment placement locations and methods.

Item 1 above was the primary objective of the project, and the chemical Sampling and Analysis Plan for the investigation was designed to answer the following principal study question:

Is there any chemical contaminant in sediments to be dredged from Marshall Lake or North Park Lake present at a concentration that could pose a significant risk to human health or the environment if the dredged sediments are placed in an upland area within North Park?

1.4 Relevant Standards and Criteria

There are a variety of relevant criteria, beginning with the scope of work for the project and proceeding through development of the Project Work Plan (PWP). The PWP is a tool for overall management of quality, safety, schedule and budget. The PWP includes a Quality Control Plan (QCP), Sampling and Analysis Plan (SAP) and a Site Safety and Health Plan (SSHP). The SAP is the most important criteria because it specified detailed procedures and provided the rationale for conducting this investigation based on compliance with relevant state and Federal regulations.

The SAP was based on the project Scope of Work and a copy of the January 16, 1998 version of the PaDEP [Draft] Dredging Guidelines provided in the request for proposal from CELRP for the project. In accord with the scope of work, the PaDEP was consulted to determine if the [Draft] Dredging Guidelines have been updated. PaDEP indicated that these draft guidelines are no longer published. Further inquiry indicated that PaDEP's intent is to

regulate placement of dredged materials as "fill material." The regulation of fill has been contentious in Pennsylvania, and the applicable regulations are evolving. The concerns have revolved around the potential for fill materials to contain levels of toxic chemicals that could pose significant human health hazards and whether fill materials should be subject to state solid and/or hazardous waste regulations.

The current governing standard is the "Policy And Procedure Establishing Criteria For Use Of Uncontaminated Soils, Stone, Unused Brick, And Block, Concrete And Used Asphalt As Clean Fill." This standard is based on very conservative toxicity criteria, and it does not address the use of dredge material for use as Clean Fill. The Clean Fill numeric standards for some metals are below naturally occurring levels, and for many organic compounds in the polynuclear aromatic hydrocarbon group, the limits are below or very close to the practical limits of quantitation.

The Environmental Quality Board (Board) for the Commonwealth proposed to amend Chapters 271 and 287 (municipal waste and residual waste management) of state law to provide a regulatory definition and/or rule for a more practical and less conservative standard, "Safe Fill." The amendments are the result of a comprehensive reevaluation of the present clean fill policy, and the new rule is scheduled to be issued in late 2002 or early 2003. The proposed Safe Fill Rule was published in the Pennsylvania Bulletin on February 2, 2002. The intent of the new rule is to exempt uncontaminated material to be used as fill, (materials the PaDEP considers toxicologically safe based on appropriate characterization), from the definition of waste. The exclusion of safe fill from the "waste" definition is intended to promote beneficial reuse of uncontaminated materials and preclude inappropriate applicability of waste management requirements when a construction project results in more cut than fill.

The proposed Safe Fill definition offers several options for determining whether material meets the Safe Fill standards. It places emphasis on an appropriate level of due diligence to characterize excavated materials, but allows for historical knowledge of the site to substitute for sampling and analysis if it indicates there is no plausible reason to suspect contamination. The proposed Safe Fill definition incorporates the Pennsylvania Act 2 Statewide Health Standard Medium Specific Concentration (MSC) values and provides a rule for selection of the applicable MSC criteria. For any given chemical contaminant listed, the proposed Safe Fill criteria is the lesser of two of the Act 2 Standards, the Residential Direct Contact MSC or the Residential Generic MSC value for the Soil to Groundwater Pathway. It appears that under the new rule, Safe Fill will be defined by likely potential impacts to the soil, (ie. no records or other reasonably identifiable indication of a spill or release of a toxic substance such as visual stains or odors). If significant contamination detection is considered reasonably probable, it will be determined by collection of representative data and comparison of measured site data to established numeric standards.

2.0 Technical Project Planning

2.1 Sampling and Analysis Plan (SAP) Design

2.1.1 SAP Overview

A detailed SAP was needed because there are many potential chemical contaminants that may occur in sediment, and quantifying their presence as low as the part per billion level is subject to numerous variables that may affect the veracity of the results. Failure to account for these types of variables may cause the measured data to be significantly different than the actual conditions. This generally results in one of two types of decision errors. One undesirable decision is to conclude that contaminants exist at levels that could pose an unacceptable risk to human health or the environment, when in fact, they do not. The other outcome is far less desirable, which is to conclude no toxic chemicals exist at or above unacceptable levels, when they actually exist at levels that could pose a significant risk to human health and/or the environment.

To minimize the potential for either of these types of error, the final sampling design was based on the Scope of Work and various Corps of Engineers and USEPA guidance documents. Primary references include: the Pennsylvania Department for Environmental Protection (PaDEP), "[Draft] Dredging Guideline," included in the Scope of Work; USACE EM 200-1-2, "Technical Project Planning Process", and EM 200-1-3, "Requirements for the Preparation of Sampling and Analysis Plans". Other significant sources used to guide development of the SAP were the USEPA QA/G-4, "Guidance for the Data Quality Objectives Process (DQO)", and the SW-486, "Test Methods for Evaluation of Solid Wastes - Physical/Chemical Methods," the "Pennsylvania Land Recycling and Environmental Remediation Standards Act (Act 2) Manual" and a variety of PaDEP documents and tables associated with the "Clean Fill Criteria" and the "Safe Fill Policy."

2.1.2 SAP Hypothesis

The guidance documents published by the USACE, USEPA and PaDEP strongly recommend application of the DQO process whenever quantitative chemical data is needed to support a decision. Typically, the DQO process requires using statistical methods to account for variability and measurement error in design of a chemical data acquisition plan, and to allow hypothesis testing to control the potential for making an incorrect decision based on empirical data. In an hypothesis test, the measured data and specific analysis parameters are used to test between one of two possible conditions of the environment (the null hypothesis, H_0), or an alternative condition (the alternative hypothesis, H_a). The data acquisition for this project was designed to provide definitive evidence to accept the null hypothesis or to reject the null hypothesis and to accept the alternative hypothesis.

The null hypothesis (H_0) developed for this project was:

"The 95% upper confidence level of the mean concentration in sediment of one or more of the target chemical parameters exceeds the respective PaDEP [Draft] Dredging Guideline, Safe Fill, Clean Fill or Statewide Human Health Numerical Standard for that parameter."

The corresponding alternative hypothesis (H_a) selected was:

"There is no target chemical parameter in the sediment where the 95% upper confidence limit for the mean concentration exceeds the respective PaDEP [Draft] Dredging Guideline, Safe Fill, Clean Fill or Statewide Human Health Numerical Standard for any target parameter."

2.1.3 Number, Location and Types of Samples

The general number of field samples and the method for locating samples was specified in the scope of work, based on discussion with PaDEP. Using standard PADEP sampling and analysis protocol developed to assess environmental conditions where a spill occurred or historical information indicates there is a known source of chemical contamination would have required the advancement of approximately 160 borings and the collection of a very large number samples to characterize the subject lake sediments. Due to the lack of known sources of significant contamination to either lake CELRP and the local sponsor for the project, Allegheny County, consulted the PaDEP. The result was a determination that installation of approximately 36 borings and collection of samples for analyses in accord with the PaDEP [Draft] Dredging Guideline would constitute an appropriate level of due diligence for investigation and characterization of the chemical content of sediments to be dredged for placement within the park boundaries.

Based on CELRP mapping and identification of dredging locations and depths, North Park Lake was subdivided into eight "Management Units," and the area of dredging in Marshall Lake was defined as one Management Unit. The intent was to suitably characterize the total volume of sediment to be dredged by spatially dividing North Park Lake into eight nearly equal volumes of material to be dredged, and to establish the proposed area and volume of dredging in Marshall Lake as one Management Unit. Figure 3 depicts the boundaries the eight Management Units established to subdivide North Park Lake into segments.

A total of four borings in each Management Unit was scheduled for collection of sediment samples for both geotechnical and chemical analyses. The spatial location for each of the borings within a Management Unit was determined by dividing the surface area of the Management Unit into 100 nearly equal rectangular cells sequentially numbered. A random number generator was used to select four cell numbers between 1 and 100, and the center of each of the four selected cells was chosen as the proposed boring location. Borings were advanced using hollow stem augurs and drive sampling techniques, and they were labeled according to Management Unit and boring within the unit.

The scheduled depth of each boring was determined by comparing existing to proposed contour mapping of the lake bottom. Some locations in the SAP were altered if less than one-foot of water was available or the depth of dredging was less than two feet. If the center of a selected cell did not meet these criteria, the boring was moved to a location within the cell where it could be met. If there was no suitable location within the cell, the random number generator was used to select another cell number between 1 and 100, and the same process was followed until four suitable locations were established. Each boring location was assigned a specific x and y coordinate location based on the project mapping.

Each boring was scheduled to be continuously sampled from the top of sediment to the termination depth using the environmental protocol specified in the SAP. Three types (Primary, Secondary and Tertiary) of samples were to be collected for chemical analyses from each Management Unit.

Table 1 provides a comprehensive Chemical Analysis Plan Summary of the borings scheduled to be drilled, sample intervals and designated types of samples and chemical analyses planned for the project to provide the data to test the hypotheses. Table 2 provides a comprehensive Geotechnical Analysis Plan Summary of the borings to be drilled, the sample intervals and designated types of geotechnical analyses planned for the project.

2.1.3.1 Primary Samples for Chemical Analysis

One set of Primary Samples was to be collected from each Management Unit for chemical analysis and labeled PS-(Management Unit #). Each Primary Sample was scheduled to be a composite sample comprised of representative proportions from each of the four borings in the Management Unit. Each primary samples was to be submitted for laboratory analyses for the following chemical analyses by the designated USEPA method:

- TPH - SW 846 Method 8015B
- EOX - SW 846 Method 9023
- PCBs - SW 846 Method 8082
- Target Analyte List Metals - SW 846 Method 6000/7000 Series
- Chlordane - SW 846 Method 8081A
- Chloride - 300.0.

2.1.3.2 Secondary Samples for Chemical Analysis

Four sets of Secondary Samples were to be collected from each Management Unit for potential chemical analysis, and each sample set was labeled SS-(Management Unit # + boring designation a, b, c or d). For example, sample SS-1a was the secondary sample collected from boring a in Management Unit #1. Each Secondary Sample was scheduled to be a composite sample comprised of representative proportions from the full length of the boring. They were to be collected for potential analysis by the designated USEPA method:

- TPH - SW 846 Method 8015B
- EOX - SW 846 Method 9023
- Total Lead - SW 846 Method 6000/7000 Series

2.1.3.3 Tertiary Samples for Chemical Analysis

One set of Tertiary Samples was to be collected from each Management Unit. Each set included one sample for the following potential chemical analyses:

- VOCs - SW 846 Method 8260B
- SVOCs - SW 846 Method 8270C

The VOC sample was to be a discreet sample, while the SVOC sample was a composite sample from one boring within the Management Unit. The Tertiary Sample for VOC analysis was to be a discrete sample, taken from the location suspected to contain the highest

level of Volatile Organic Compounds (VOCs). The boring and location was to be determined in the field based on initial screening of each sample from each boring with a portable Photo Ionization Detector. The boring location and depth where the highest Photo Ionization Detector reading was recorded within the Management Unit was to be re-drilled, and a discrete sample was to be procured using Encore™ samplers at the location of the highest reading. If no sample from any of the four borings within the Management Unit exhibited a Photo Ionization Detector reading above background, the Tertiary Sample location for VOC analysis was to be selected in the field by the Field Sampling Team Leader.

The Tertiary Sample for SVOC analysis was scheduled to be a composite sample from the same boring used to collect the VOC sample, comprised of representative proportions of the sediment through the full length of the boring.

3.0 Field Sampling Results

An Altech geologist directed all field sampling activities, which were conducted between October 1-12, 2002. All planned samples listed in Tables 1 and 2 were procured during this period. Appendix A provides a complete set of detailed subsurface exploration records for all 36 borings advanced and sampled for the project. Figure 4, the Boring Location Plan for samples collected at North Park Lake, and Figure 5, the Boring Location Plan for Marshall Lake, depict the general limits of the lakes, the limits established for each Management Unit, existing and proposed topographic contours and the actual location of borings drilled and sampled for this project.

3.1 Sample Locations

Best effort was made to locate each boring at the exact point within each Management Unit specified in Tables 1 and 2. Planned to actual field boring locations varied only slightly in 35 of the 36 borings. The exception, Boring AD-1c in Management Unit 1, was nearly 200 feet east of its intended location and fell just within the eastern boundary of Management Unit 1. All other borings were generally within 20 feet of the intended location, and actual boring location coordinates were measured in the field using a portable differential Global Positioning Satellite system. Table 3 provides a comprehensive summary of all samples collected for the project, and it depicts the actual rather than planned sample coordinate locations. Figure 4, the Boring Location Plan for North Park Lake, and Figure 5, the Boring Location Plan for Marshall Lake depict the actual boring locations and indicate also if the boring was used to collect samples for both geotechnical and chemical laboratory analyses.

The four original locations designated in each Management Unit were based on random selection, and the amount of spatial variation between the planned and actual sample locations is within tolerable limits. There is no reason to believe that there would be any bias in sample results based on the variation between selected random sample locations and the actual locations sampled in the field.

3.2 *Field Sampling Procedures*

Altech subcontracted (Pennsylvania Drilling Co.) for a floating plant, drill rig and operator to procure the scheduled sediment samples from North Park and Marshall Lakes. A skid mounted hollow stem augur drill rig was situated on a floating platform and continuous stainless steel split spoon drive sampling was conducted to collect all samples in general conformance to ASTM Designation D 1586, "Penetration Test and Split-Barrel Sampling of Soils."

Using ASTM D 1586, powered hollow stem augurs are used to advance the boring to the top of the desired sample interval. A driving shoe is placed at the lead end of a standard 18-inch long by 1.4-inch I.D., 2-inch O.D. split-spoon sample tube, and the tube is attached to a string of drill rods and inserted and centered within the hollow stem augurs. The sampler is first seated six inches to penetrate any loose soil cuttings that may have heaved up through the hollow stem augur, then it is driven an additional 12 inches with incremental blows of a 140-pound hammer falling 30 inches. The number of blows required to advance the sampler the initial six inch seating depth and each subsequent six inches for the final foot are recorded.

The total number of blows for the final foot are designated the "standard penetration resistance" (N-value), according to ASTM D 1586. The standard penetration resistance provides an index to soil strength and density and is commonly used to estimate soil bearing capacity and support geotechnical engineering design. The string of drill rods attached to the split-spoon sampler is then extracted from the augurs. The sample tube is opened, evaluated, and if specified, representative portions are placed in sealable glass jars for laboratory determination of geotechnical properties, (i.e. grain size, moisture content, etc.). The augurs are then advanced to the top of the next designated sample interval and a drill string with a clean split-spoon sampler is inserted and seated within the hollow stem augurs for collection of the next sample as described above.

The ASTM D 1586 procedure was slightly altered to include environmental sampling protocol. Stainless steel sampling equipment and meticulous handling and decontamination procedures were selected and followed to maximize the integrity and suitability of the samples for chemical analyses. The split-spoon sampling tubes used were made of stainless steel and the driving length of the tubes was 24 rather than 18 inches. The blows for each six inches of penetration of the tube were recorded. The total numbers of blows from the middle two segments of each two foot sample run provide a close approximation of the standard penetration resistance of the sediments. The numbers of blows for the middle two segments of each two foot sample run were used to estimate N-values and soil consistency. However, the sediments, especially near the surface, were very soft, and often the weight of the drill rods and stainless steel split-spoon sampler caused penetration of the sampler without use of the 140-pound hammer.

Upon arriving at each location, the Field Sampling Team Leader (Altech geologist) used a weighted tape to measure the depth below the surface to the top of sediment. The measured value was compared to the planned depth, and if significantly greater, the location was moved slightly as needed to make sure the required depth of sediment sampling could be accomplished.

Once suitably anchored over the drill location, a string of hollow stem augurs were lowered (suspended) to the top of the sediment, a 24-inch long by 1.4-inch I.D., 2-inch O.D. stainless steel split-spoon sample tube was attached to a string of drill rods and inserted, centered within the hollow stem augurs and allowed to fall up to 24 inches under the combined weight. If penetration was less than 24 inches, the hammer was attached to the drill string and allowed to fall under the combined weight to achieve 24 inches of penetration below the sediment surface. If penetration was less than 24 inches, the hammer was then raised 30 inches and allowed to free fall drive the drill string 24 inches into the sediment.

When the required 24 inches of penetration was achieved, the drill string was extracted, and the stainless split-spoon sampler was separated and provided to the Field Sampling Team Leader or his assistant to open, perform field screening, observe, prepare and segregate sediments into appropriate containers as described below. Upon collection of each surface sample, the driller then allowed the augurs to sink two feet to the top of the next sample interval, and sampling with a clean stainless steel split spoon was conducted according to the same procedure described above. The same sequence was followed until the designated depth of sampling was accomplished in each boring.

Immediately upon removal of the cutting shoe and cracking each split-spoon sample tube open, the Field Sampling Team Leader or his assistant used a calibrated Photoionization Detector (PID) with a 10.7 eV lamp to detect potential contamination by volatile organic compounds (VOCs). The PID was calibrated each day using a known standard of isobutylene at 100 parts per million. For field screening, the PID sensor probe was systematically placed at one end of the split spoon sample tube approximately one inch from the exposed sediment sample and slowly passed along the length of the tube.

Every sample was subjected to field screening with a PID as described above. However, no sample exhibited a concentration of a VOC reading above 1 part per million. Since the field screening was intended to identify the most likely location(s) to detect VOC contamination if present and provide the basis for Tertiary VOC Samples, all planned Tertiary Samples were collected at the fourth boring drilled in each Management Unit.

3.3 Field Sample Preparation

Samples for chemical and geotechnical laboratory analyses were prepared for each Management Unit. Table 3 provides a summary of the borings advanced and the samples collected for this project. The Primary Samples collected were representative composites of all the material sampled through the full depth of all four borings within the Management Unit, while the Secondary Samples were composites unique to the individual borings within the Management Unit. The Tertiary Geotechnical samples were a combination of discrete and composite samples.

3.3.1 Chemical Sample Preparation

At the first boring in each Management Unit, representative portions of each split spoon sample were collected through the full depth of the boring and placed in a large clean

stainless steel mixing bowl. Using a clean stainless steel spoon, the sample was homogenized to consistent particle size distribution by stirring the material in a circular fashion. Once the mixing was completed, the sample was quartered. Approximately 1/4 of the contents was transferred with a large stainless steel spoon to a separate large clean stainless steel mixing bowl for Primary Sample collection. This bowl was then covered with a clean sheet of aluminum foil and set aside awaiting representative portions of the second, third and fourth boring from the Management Unit. The contents of the 3/4 full stainless steel bowl were then used to fill the secondary sample jars for the first boring. The order of sample collection was TPH, EOX, Chlordane, PCBs, TAL metals and chloride. Each of the jars was filled to the brim to minimize air space in the container and the lid was tightly secured. The remaining sediment was then transferred to a clean 5-gallon bucket for accumulation of the geotechnical sample or to be containerized as Investigation Derived Waste (IDW).

Samples collected from the second, third and fourth borings were prepared in the same manner, splitting 1/4 of sediment retrieved through the total length of boring for the Primary Sample and 3/4 of the material for the Secondary Sample. All sediment remaining from the Secondary Sample bowl for each boring was transferred to a 5-gallon bucket for accumulation of soil for the geotechnical sample an/or collection of IDW. Upon collection and placement of representative portions from each of the four borings into the large stainless steel mixing bowl for the Primary Sample, the sample jars for the Primary Samples were filled in accord with the following sequence; TPH, SVOC (Tertiary Sample), EOX, Chlordane, PCBs, TAL Metals, and Chloride.

Although the borings were labeled a, b, c and d, they were not necessarily advanced in accord with that sequence. The Tertiary Sample from each Management Unit for potential VOC analysis was a discreet sample, procured from the location in the fourth boring judged by the Field Sampling Team Leader to have the greatest potential to contain VOC contamination. Three new 5 gram Encore™ Samplers were directly pushed into the open split spoon sample at the selected location as quickly as possible to minimize loss of any organic content. The Tertiary Sample from each Management Unit for potential SVOC analysis was a composite sample of representative material through the entire length of the fourth boring. For all intents and purposes, the SVOC Tertiary Samples were field duplicates of the Secondary Sample from the fourth boring in each Management Unit.

3.3.2 Geotechnical Sample Preparation

At each boring and sample interval where sampling for moisture content was scheduled, a discreet sample approximately 2 inches long was extracted from the sample tube using clean stainless steel utensils and placed in a 4-ounce jar for moisture content determination. For geotechnical index property tests representative composite geotechnical samples from specified sample intervals in selected borings, a minimum of one in each Management Unit were prepared. The composite sediment geotechnical sample for each Management Unit consisted of two 32-ounce glass jars.

3.4 Sample Packaging, Custody and Transport

Chemical sample containers were virgin bottleware, free of foreign substances and provided by STL Laboratories, Inc. Stick-on labels were affixed and clear tape was placed around containers and fixed over labels to prevent deterioration of the labels during handling and shipping. The containers for each sample location were placed in zip lock plastic bags and placed into a cooler for transport. In the field, each sample container label was marked in permanent ink with the sample identification number, date, sampler's name, time of collection, place of collection, parameter(s) requested and sample type or matrix.

The scheduled field duplicate samples in Management Unit 5 were assigned fictitious sample identification as Management Unit 10 samples to disguise the true identity, and the laboratory was not given information concerning the true identity of the field duplicate samples. The sample-collection containers specific to each sample type were consistent with the requirements of EM 200-1-3 and USEPA SW-846. Clean sample containers with teflon lined seals or septa were procured from the laboratory. Field preservation was accomplished by rapidly placing prepared sample jars in plastic bags and putting them on ice in coolers.

All samples for chemical analysis were stored in an ice chest on wet ice while in the field and in a manner that protected the sample from breakage. Samples were delivered to the laboratory at the end of each day they were collected. Ice packs were used to lower and maintain a temperature of 4°C (+/- 2°C) in the coolers during shipping. A Chain-of-Custody form accompanied all samples from the time of collection until the laboratory received them. Each party in possession of the samples was required to sign the Chain-of-Custody form signifying receipt. A copy of the original completed form was provided by the laboratory along with the laboratory report of results presented in Appendix D.

3.5 Blank Samples and Investigation Derived Wastes

A QC measure implemented to assess field investigation equipment and procedures was collection of rinse blank samples for chemical analyses. One representative Rinse Blank was obtained by pouring commercially purchased deionized water into a stainless steel mixing bowl containing a stainless steel knife and spoon, all of which had been used to collect and prepare a field sample and then decontaminated as specified in the Section below. The Rinse Blank Sample was analyzed for all Primary, Secondary and Tertiary Chemical Analysis Parameters. As an additional QC measure, a Trip Blank Sample comprised of commercially purchased deionized water poured into a clean sampling jar was also submitted for laboratory analysis for VOCs.

All excess sediment collected and not placed into sample jars for chemical or geotechnical analysis was placed in 5-gallon pails and transferred to a 55-gallon drum for disposal after analyses. Decontamination solutions generated by the sediment sampling were also collected in five-gallon pails with secure lids and transferred to the 55-gallon drum. A representative sample was procured of the material in the nearly full 55-gallon drum of investigation derived waste (IDW) generated by the field sampling. This IDW sample (labeled DR-1) was also analyzed for all Primary, Secondary and Tertiary Chemical Analysis Parameters.

3.6 Decontamination of Equipment

All non-disposable sampling equipment was thoroughly cleaned between sample locations to prevent cross-contamination. Cleaning took place at a portable cleaning station established on the floating plant, and all visible signs of soil were removed from all equipment that could come in contact with sediment sample material by scouring with dedicated bristle type brushes. The cleaning or decontamination procedure consisted of the following steps for each piece of equipment that could come in contact with samples for chemical analyses:

- Scrub and wash all used equipment sections in a non-phosphate detergent solution,
- Single rinse with lake water, beyond which all visible signs of detergent are removed,
- Double rinse with lake water,
- Air dry, and
- Field Sample Team Leader inspection and approval for reuse.

Decontamination was performed on the stainless split-spoons, knives, spatulas, spoons, etc. prior to drilling at the next boring location. The equipment was also decontaminated before it left the site.

4.0 Field Characterization and Laboratory Analysis Results

The following summary description of subsurface conditions encountered at North Park and Marshall Lakes is based on the information presented in the Appendices. The Appendices include a complete set of boring records, field and all geotechnical and chemical laboratory test records that document all significant project results. Appendix A provides a complete set of boring records and geotechnical laboratory test results. Appendix B is comprised of a set of summary tables and a companion discussion of the chemical analysis results for all field and QC samples analyzed for the project. Appendix B presents a data quality assessment of the measured data relative to the QC acceptance criteria in the project SAP for use of the data to support project decisions. Appendix D is the complete set of laboratory test reports for all chemical analyses performed for the project, including documentation of all significant internal laboratory QC observations and measurements.

The number of borings, depths, locations, sample intervals and chemical and geotechnical analyses performed were systematically designed to provide representative data of the actual subsurface conditions. However it must be noted, the spot locations of the 36 borings advanced and the samples collected comprise a very small fraction of the total population of sediments and underlying materials that were the subject of the investigation. Further, regardless of the thoroughness of a geotechnical or environmental investigation, there is always a possibility that conditions encountered in construction may be different from the conditions encountered at specific boring locations at the time of the investigation phase. Also, the construction process itself may alter subsurface conditions and result in different circumstances then indicated at the time of the investigation.

The following summary descriptions of the geotechnical and chemical conditions lake-wide and summary tables of sampling and analysis results are based on professional judgment from field observations and preparation and review of the complete set of boring records and geotechnical and chemical analyses presented in the Appendices. The Appendix material is intended to provide objective summary documentation of the results of the exploration, and it is intended to provide the basis for independent evaluation and conclusions regarding the subsurface conditions and the identification and selection of an optimum combination of dredge and sediment placement options for inclusion in the Feasibility Study Report for the project.

4.1 Subsurface Conditions and Geotechnical Analysis Results

The Altech field geologist systematically examined and documented the characteristics of the soil and sediment from each boring. An estimate of consistency was made, and the sample color and grain size characteristics were denoted in a field logbook, along with blow count records, percentage of recovery in sample intervals, depth of water and other relevant information and observations.

The Altech Field Sample Team Leader (geologist) assigned a Unified Soil Classification Symbol (USCS) to the sample that best depicted the characteristics, and prepared the original drafts of the Boring Logs presented in Appendix A. A geotechnical engineer reviewed the draft logs and revised them to include and provide consistency with the geotechnical laboratory analysis results and USCS designations. Appendix A also contains a comprehensive summary of the geotechnical laboratory tests for moisture content, grain size, atterberg limits, specific gravity and organic content loss on ignition.

Table 2 depicts the planned geotechnical analyses. Tables 4 and 5 depict the results of the geotechnical analyses. Table 4 provides the borings, depths, USCS designations and results of moisture content analysis on 72 discrete soil samples. Table 5 depicts the results of index property tests. Supporting gradation curves and the complete set of geotechnical analysis results are presented in Appendix A.

4.1.1 North Park Lake

Fairly consistent subsurface conditions were encountered in the borings in Management Units 1 through 5 of North Park Lake. The sediment was generally a very soft greenish gray silty clay with organics. It was generally designated as CL type soil according to the Unified Soil Classification System (USCS). Near the sediment surface, soil particles were nearly in suspension. There was apparent increase in density with depth and measurable decrease in moisture content with depth. Percent recovery in split-spoon samples from each boring also increased with depth of sample interval.

The thickness of these very soft silty clays in Management Units 1 through 5 extended to greater than 11 feet. A very loose silty sand, generally designated as SM according to the USCS, was encountered beneath the very soft silty clay in most of the borings where geotechnical samples were procured. All moisture content values for the underlying sand at these locations were significantly lower than the overlying clays. The consistent greenish

gray sediment color indicated the presence of algae and a pervasive reducing environment where anaerobic decomposition of organic matter is occurring.

In Management Units 6 through 8 North Park Lake, subsurface conditions were noticeably different from those encountered in Management Units 1 through 5. The thickness of very soft sediment encountered was generally less than two feet before denser, apparently non-lacustrine sediments and soils were encountered. The soils encountered in Management Units 6 through 8 in North Park Lake varied from high plasticity clays with virtually no coarse fraction to silty sands to clayey gravels. USCS designations included; CH, CL, SM, SC and GC type soils. The soils encountered in Management Units 6 through 8 in North Park Lake were generally denser, exhibited more variable grain size distribution characteristics and lower natural moisture content values than the values found for samples from the Management Units up the Pine Creek Arm and in the area adjacent to the dam.

The consistent greenish gray coloring found in all but one surficial sample in Management Units 1 through 8 borings indicated that presence of algae is ubiquitous throughout North Park Lake and that the lake is eutrophic. The yellow-orange clayey sand and gravelly clay encountered in borings AD-7a and AD-7c appear anomalous, but these conditions likely reflect native soil environments near the shore rather than the reducing environment that pervades the lake bottom.

4.1.2 Marshall Lake

Marshall Lake sediments encountered in the Management Unit 9 borings were very soft gray silty clays near the surface (CL), underlain by a very loose silty to clayey sand with gravel (SM-SC). The thickness of the very soft silty clay was greater than 5 feet in boring AD-9b, but was two feet or less in borings AD-9c and AD-9d. A noteworthy difference between the samples extracted from both lakes was the absence of a greenish hue to the Marshall Lake samples.

4.1.3 Index Property Test Results

The organic content loss on ignition test result values found in the surficial sediments were consistently higher than the values found in the underlying sediments, and were as high as 4.7%. With the exception of the GC type soil found at AD-7a, soil specific gravity measurements were in a rather tight range from 2.63 to 2.72. Atterberg Limit tests indicate that sediment fines generally exhibit low to moderate plasticity. Liquid Limit values for 14 of the 15 samples tested ranged from 23% to 47% and Plasticity Index values ranged from as low as 7% to 25% in those samples. The sample from boring AD-7d was the anomaly, exhibiting a liquid Limit of 59% and a Plasticity Index of 34%. The AD-7d sample results plotted as CH (high plasticity clay), while 12 of the 15 values plotted as CL (low plasticity clay) and two plotted as ML-CL (low plasticity silty clay to clayey silt).

4.2 Chemical Analysis Results

A primary goal for this project was to produce chemical data of sufficient quality and quantity to develop a reliable estimate for the mean concentration of any potential

contaminant that may be present in the sediments tentatively scheduled to be dredged. Some censored data, (Data that has been qualified by the Laboratory QC Manager) was used, based on the Quality Control analyses and calculation results presented in Appendices B and C. For instance, some analytes were detected at concentrations below the Reporting Limit (Below the value that the presence of the analyte can be quantified within pre-established limits for precision and accuracy) and reported with a "j" (organic compounds) or a "B" (metal) qualifier to indicate the reported value is an estimate.

The results of the chemical analyses used to test the null and alternate hypotheses developed for the investigation are summarized in Tables 6 through 8. The chemical analysis results are also presented next to the Management Units from which the samples came in Figures 6, 7 and 8. The results of descriptive statistical calculations used to assess the data are presented in Tables 9 through 12.

4.2.1 Total Petroleum Hydrocarbons

Total Petroleum Hydrocarbons (TPH) were detected in all 10 Primary Samples. The concentrations ranged from a low estimated at 12 mg/Kg to high of 210 mg/Kg. As shown in Table 6, the mean value of all 10 samples is 93 mg/Kg, but four of the ten Primary Samples (PS-1, PS-3, PS-5 and PS-10) exceeded the PaDEP [Draft] Dredging Guideline "Unrestricted Use" criteria of 120 mg/Kg. Additionally, two samples (PS-3 and PS-10) exceeded the "Single Sample Limit" criteria of 200 mg/Kg for unrestricted residential property use. Consequently, the Secondary Samples from MU-1, MU-3, MU-5 and MU-10 were then analyzed.

TPH concentrations in all of the Secondary Samples from MU-1 and MU-3 were below the corresponding Primary Sample results and were all below the Unrestricted Use criteria. However, TPH concentrations in four of the eight Secondary Samples from MU-5 exceeded the Unrestricted Use Criteria of 120 mg/Kg, with the highest concentration of 230 mg/Kg found in two samples, SS-5c and SS-10d. While no value exceeds the Single Sample Limit for Unrestricted Use for Residential property, three of the ten total samples from MU-5 exceeded the Residential Use Single Sample Limit criterion of 200 mg/Kg. The mean value of these ten MU-5 samples is 147 mg/Kg, which also exceeds the Unrestricted Use criteria of 120 mg/Kg.

4.2.2 Target Analyte List Metals, Including Lead

Metals results are presented relative to three standards. Lead was evaluated relative to the PaDEP [Draft] Dredging Guideline, and lead and all other metals are evaluate relative to both the Clean Fill and Safe Fill criteria. Also, the table of, "Trace Chemical Element Content of Natural Soils," published by the USEPA OSWER in 1983 was referenced, which indicates the common range of lead concentrations in soil is 2 mg/Kg to 200 mg/Kg, with an average value of 10 mg/Kg. Primary Sample results for lead are depicted in Table 6, and the complete set of Target Analyte List Metals results are summarized in Table 8. Table 6 provides the PaDEP [Draft] Dredging Guidelines for relevant comparison, and Table 8 provides the PaDEP Clean Fill and proposed Safe Fill criteria for relevant comparison.

Lead was detected in all 10 Primary Samples. The concentrations ranged from a low of 15.8 mg/Kg to a high of 66.7 mg/Kg. As shown in Table 6, the mean value of all 10 samples is approximately 39 mg/Kg. Three of the ten Primary Samples exceeded the PaDEP [Draft] Dredging Guideline "Unrestricted Use" criteria of 45 mg/Kg, PS-3, PS-5 and PS-10. Consequently, the Secondary Samples from MU-3 and MU-5 were then analyzed.

Lead concentrations in all Secondary Samples exceeded the Unrestricted Use Criteria of 45 mg/Kg. The values in MU-1 fit a relatively tight range from 48.9 to 70.6 mg/Kg, and the mean for all MU-3 lead concentration results was 55.8 mg/Kg compared to the PS-1 composite sample value of 49.6 mg/Kg. The values in MU-5 fell in a wider range from 54.3 to 84.8 mg/Kg, and the mean for all MU-5 lead concentration results was 67.2 mg/Kg. Lead values consistently exceed the Clean Fill value for lead of 20 mg/Kg, but are far below the Safe Fill value of 450 mg/Kg.

From the list of 23 Target Analyte List metals for Primary Samples 1 through 10, only two, Antimony and Thallium were not detected in the sediments. However, there were no metals detected in any of the sediments above the proposed Safe Fill criteria, and only six metals were found in the sediments at concentrations above the very conservative Clean Fill criteria.

Of all of the metals results, only arsenic was found at concentrations approaching the Safe Fill criteria. The highest concentrations (11.7 and 11.9 mg/Kg) detected were in Management Unit 5 (Samples PS-5 and split duplicate PS-10). The 95% upper confidence level of the mean concentration of arsenic in the 10 Primary Samples is slightly less than 10 mg/Kg, which is below the Safe Fill criterion of 12 mg/Kg but above the 0.3 Clean Fill criterion. Coincidentally samples PS-5 and split duplicate PS-10 also contained the highest TPH, chlorides, aluminum, barium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, vanadium and zinc values detected. As further described in Appendix B and is evident from examination of the results in Tables 6, 7 and 8, the results of the analyses of the duplicate samples (PS-5 and PS-10) were in close agreement for all analysis parameters, which indicates a high degree of precision in the field and laboratory sample collection and analyses processes.

4.2.3 Other Primary Sample Analysis Parameters

All ten Primary Samples were also analyzed for Total Extractable Organic Halogens (EOX), Polychlorinated Biphenyls (PCBs), the pesticide Chlordane and total chloride content. Of these parameters, only chlorides were detected. Chlorides were detected in all ten samples, and the concentrations found in PS-5 (184 mg/Kg) and PS-10 (177 mg/Kg) were generally two to five times larger than all other sample results. The mean value of chlorides detected was 83 mg/Kg, and the 95% upper confidence level for the mean concentration was calculated to be 124 mg/Kg, relative to the PaDEP published Safe Fill value of 250 mg/L for chlorides for dredge material and sediments. It is assumed that this standard is intended for ocean harbor and estuary dredging projects where salt could pose a potential environmental concern at a placement area. The sediment chloride content values detected do not appear to reflect contamination and are far below the part per million Safe Fill standard.

No PCB compound was detected, and the quantitation limits for individual PCB aroclor isomers ranged from 34 to 52 ug/Kg in the analyses, well below the Unrestricted Use criterion of 1000 ug/Kg. Likewise, no EOX compound was detected in any of the ten samples. Quantitation Limits for EOX ranged from 14 to 22 mg/Kg, below the Unrestricted Use criteria of 25 mg/Kg. Analyses results for chlordane were all non-detect, but the limits of quantitation in the analyses ranged from 18 to 27 ug/Kg relative to the Unrestricted Use criteria of 20 ug/Kg. However, Method Detection Limits for all ten samples were all approximately 2 ug/Kg, and if present above this level would have been detected and reported as an estimated value by the laboratory analyst. The SAP identified the Unrestricted Use criteria of 20 ug/Kg as potentially not achievable in analysis of the sediments, and the data was considered suitable to support investigation hypothesis testing.

4.2.4 Tertiary Sample Chemical Analysis Results

Tertiary Samples TS-1, TS-3, TS-5 and TS-10 were analyzed, but the analyses did not meet all project QC criteria specified in the SAP for use in quantitative determinations of the nature and extent of potential contamination. Summary results of these analyses are presented in Appendix B, and the complete set of chemical laboratory test reports is provided in Appendix D. A qualitative decision was made by the Altech Project Manager to order these analyses after receipt of the Secondary Sample data for TPH, even though PaDEP [Draft] Dredging Guideline criteria for the mean concentrations had not been exceeded. While it was known at that time that the method specified holding time between sampling and extraction had been exceeded, the additional data regarding the most likely toxic TPH SVOC constituents that might be present was considered valuable supporting information. No individual SVOC was detected in any of the four samples above 0.5 mg/Kg, and the Tertiary Sample results provide supporting documentation of the absence of toxic substances at potentially threatening levels.

4.2.5 Blank and IDW Sample Results

Tables B-11 and B-12 and B-13 and B-14 in Appendix B summarize the results of analysis of a Rinse Blank sample labeled RB-1 and an Investigation Derived Waste (IDW) sample (DR-1). The results of analysis of the Trip Blank sample (TB-1) are summarized in Table B-14. No analyte was detected in the TB sample. Eleven different metals were detected in the Rinse Blank sample RB-1 at low levels, several of which were also found in the Laboratory Control Sample method blank analysis. All but two of the 23 metals were detected in the IDW sample, but none exceeded levels requiring regulated waste disposal.

4.3 Descriptive Statistical Calculations for TPH Sediment Concentration Data

Tables 9 and 10 provide summaries of descriptive statistical calculations for the TPH data for the combined North Park Lake and Marshall Lake sediments and North Park Lake only sediments, respectively. Column one of these tables lists the descriptive statistical parameter. Column two provides descriptive statistics for the entire Primary Data Set for TPH. Column 3 provides descriptive statistics for the entire Primary Data Set for TPH, with the exception that the value assigned for Management Unit 5 is the mean of the PS-5 and PS-10 samples. Columns 4, 5 and 6 present descriptive statistics for the set of Secondary samples from

Management Units 1, 3 and 5 respectively, and Column 7 presents descriptive statistics for the entire data set, with the mean values of the Secondary Samples from these three Management Units substituted for the Primary Sample Results. Columns 8, 9 and 10 present descriptive statistics for the combined set of Primary and Secondary samples from Management Units 1, 3 and 5 respectively, and Column 11 presents descriptive statistics for the entire data set, with the mean values of the combined Primary and Secondary Samples from these three Management Units substituted for the Primary Sample Results.

As shown in Table 9, in North Park Lake, the mean value for all nine Primary Samples was 101 mg/Kg, and the 95% UCL for the mean was 165 mg/Kg. Substituting the average value of the split duplicate samples into the data set for the PS-5 and PS-10 values resulted in a mean for the eight values of 89 mg/Kg and a 95% UCL of 156 mg/Kg. Mean values for the MU-1, MU-3 and MU-5 Secondary Samples were 67.5, 77.5 and 134.9 mg/Kg, respectively. Mean values for the combined MU-1, MU-3 and MU-5 Primary and Secondary Samples were 80, 104 and 146.9 mg/Kg, respectively. Following the PaDEP [Draft] Dredging Guideline, each of these values was substituted into the original Primary Sample data set for the PS-1, PS-3 and PS-5 results, and the mean and 95% UCL for the mean were calculated to be 63.5 and 104 mg/Kg, respectively. The 95% UCL value is below the Unrestricted Use criteria of 120 mg/Kg.

Using the same approach for the combined sediments from both lakes, the mean value for all ten Primary Samples was 93.1 mg/Kg, and the 95% UCL for the mean was 152 mg/Kg, as shown in Figure 10. Substituting the average value of the split duplicate samples into the data set for the PS-5 and PS-10 values resulted in a mean for the nine values of 81.8 mg/Kg and a 95% UCL of 142 mg/Kg. Mean values for the MU-1, MU-3 and MU-5 Secondary Samples were 67.5, 77.5 and 134.9 mg/Kg, respectively. Mean values for the combined MU-1, MU-3 and MU-5 Primary and Secondary Samples were 80, 104 and 146.9 mg/Kg, respectively. Following the PaDEP [Draft] Dredging Guideline, each of these values was substituted into the original Primary Sample data set for the PS-1, PS-3 and PS-5 results, and the mean and 95% UCL for the mean were calculated to be 59.1 and 95 mg/Kg, respectively. The 95% UCL value is below the Unrestricted Use criteria of 120 mg/Kg.

4.4 Descriptive Statistical Calculations for Total Lead Sediment Concentration Data

Descriptive statistics for the lead sample results are presented in Tables 11 and 12, with Table 11 specific to North Park Lake, and Table 12 depicting the results for the combined set of Marshall Lake and North Park Lake samples. In North Park Lake, the mean value for all nine Primary Samples was 40.2 mg/Kg, and the 95% UCL for the mean was 52.3 mg/Kg. Substituting the average value of the split duplicate samples into the data set for the PS-5 and PS-10 values resulted in a mean for the eight values of 37.1 mg/Kg and a 95% UCL of 51.5 mg/Kg. Mean values for the MU-3 and MU-5 Secondary Samples were 57.4 and 67.8 mg/Kg, respectively. Mean values for the combined MU-3 and MU-5 Primary and Secondary Samples were 55.8 and 67.2 mg/Kg, respectively. Following the PaDEP [Draft] Dredging Guideline, each of these values was substituted into the original Primary Sample data set for the PS-3 and PS-5 results, and the mean and 95% UCL for the mean were

calculated to be 38.2 and 52.7 mg/Kg, respectively. The 95% UCL value is above the Unrestricted Use criteria of 45 mg/Kg.

Using the same approach for the combined sediments from both lakes, the mean value for all ten Primary Samples was 38.6 mg/Kg, and the 95% UCL for the mean was 50.7 mg/Kg, as shown in Figure 12. Substituting the average value of the split duplicate samples into the data set for the PS-5 and PS-10 values resulted in a mean for the nine values of 35.6 mg/Kg and a 95% UCL of 47.3 mg/Kg. Mean values for the MU-3 and MU-5 Secondary Samples were 57.4 and 67.8 mg/Kg, respectively. Mean values for the combined MU-3 and MU-5 Primary and Secondary Samples were 55.8 and 67.2 mg/Kg, respectively. Following the PaDEP [Draft] Dredging Guideline, each of these values was substituted into the original Primary Sample data set for the PS-3 and PS-5 results, and the mean and 95% UCL for the mean were calculated to be 36.6 and 49.3 mg/Kg, respectively. The 95% UCL value is slightly above the Unrestricted Use criteria of 45 mg/Kg.

5.0 Conclusions

The boring records appear to confirm that the major source of sediment load to North Park Lake has been Pine Creek. The thickness of very soft sediments was far greater in Management Units 1 through 5, which encompass the Pine Creek Arm of the lake and the area adjacent to the dam, than in Management Units 6, 7 and 8, which extend up the North Fork Arm of the lake. It appears that Marshall Lake has performed like retention basin where sediment carried from upstream in the North Fork watershed is retained, or there has been far less soil disturbing development in the North Fork Pine Creek upstream watershed.

The chemical analysis component of the Sampling and Analysis Plan for the investigation was designed to answer the following principal study question:

Is there any chemical contaminant in sediments to be dredged from Marshall Lake or North Park Lake present at a concentration that could pose a significant risk to human health or the environment if the dredged sediments are placed in an upland area within North Park?

The data acquisition for this project was designed primarily to minimize the risk of not detecting contamination if it was present. The numbers of samples, the types of chemical analysis parameters and the decision logic for increasing the number of analyses were all designed to detect and quantify contamination if it was present; thereby minimizing the potential of risk of the data leading to a wrong answer to the principal study question. Consequently, the scientific method was used to develop the design to provide quantitative data meeting specified data quality criteria to base acceptance of the following null hypothesis or to reject the null hypothesis and to accept the alternative hypothesis.

The null hypothesis (H_0) developed for this project was:

"The 95% upper confidence level of the mean concentration in sediment of one or more of the target chemical parameters exceeds the respective PaDEP [Draft] Dredging Guideline,

Safe Fill, Clean Fill or other applicable Statewide Human Health Numerical Standard for that parameter."

The corresponding alternative hypothesis (H_a) selected was:

"There is no target chemical parameter in the sediment where the 95% upper confidence limit for the mean concentration exceeds the respective PaDEP [Draft] Dredging Guideline, Safe Fill, Clean Fill or any other applicable Statewide Human Health Numerical Standard for any parameter."

Based on the results of the Primary Analyses, the null hypothesis was rejected and the alternative hypothesis was accepted for PCBs, Chlordane and Total Organic Halogen content. The data provides convincing evidence to support the conclusion no PCBs, Chlordane or Total Organic Halogen compound is present in sediments to be dredged from Marshall Lake or North Park Lake at a concentration that could pose a significant risk to human health or the environment if the dredged sediments are placed in an upland area within North Park. This conclusion applies both for the North Park Lake sediments alone and the combined sediments from both North Park and Marshall Lakes. No statistical determination of the 95% Upper Confidence Level (95% UCL) for the mean value was needed because none of these parameters was detected in any of the samples.

TPH is an indicator of contamination by any of a very large number of potential hydrocarbon compounds, and it has been found to occur naturally in association with petroleum containing shale and coal formations. Likewise, lead is a naturally occurring element, and is almost always detected in soil samples. The table of, "Trace Chemical Element Content of Natural Soils," published by the USEPA OSWER in 1983 indicates the common range of lead concentrations in soil is 2 mg/Kg to 200 mg/Kg, with an average value of 10 mg/Kg. Both of these analytical parameters, lead and TPH were found at levels of potential concern, which resulted in additional testing.

The null hypothesis for TPH and lead was accepted based on analysis results of the Primary Samples. As described in Section 4.3 though, substituting the mean from the combined Primary and Secondary Sample results for each respective individual Primary Sample TPH value in Management Units 1, 3 and 5, the 95% UCL value was significantly below the hypothesis test threshold Unrestricted Use value of 120 mg/Kg. For the combination of Marshall Lake and North Park Lake, the 95% UCL value was As described in Section 4.4, substituting the mean from the combined Primary and Secondary Sample results for each respective individual Primary Sample lead value in Management Units 3 and 5, the 95% UCL value for lead was significantly below the hypothesis test threshold Unrestricted Use value of 120 mg/Kg. For North Park alone, the 95% UCL value for the mean TPH concentration was 104 mg/Kg, and it was 95 mg/Kg for the combined sediments from both lakes.

If the intent were to use the sediment as fill for residential purposes, the null hypothesis would be accepted regardless of the Secondary Sample results because several individual sample results exceeded the Single Sample Limit for Unrestricted Use of fill for Residential purposes of 200 mg/Kg. However, no TPH concentration in sediment exceeded 50% of the standard for Unrestricted Use of fill for Non-Residential purposes of 500 mg/Kg.

Consequently, the null hypothesis is accepted for TPH, and the data clearly supports a conclusion that sediment placement anywhere within the park should pose no significant risk to human health.

For lead, the null hypothesis is accepted relative to both the PaDEP [Dredging Guideline and Clean Fill criteria (45 mg/Kg and 20 mg/Kg, respectively)]. However, both of these standards are very conservative, and the results were generally less than 15% of the Safe Fill criteria of 450 mg/Kg.

In summary, the results of this investigation constitute a due diligence effort to sample analyze and otherwise characterize sediments proposed to be dredge as part of the North Park Lake Aquatic Ecosystem Restoration project. While the data reflects levels of some chemicals of potential concern above naturally occurring levels, the result of the investigation is convincingly evidence that significant levels of toxic chemicals (levels of toxic substances that could pose adverse human health risks if the sediments are placed in an upland area within the park) are not likely to be present in sediments in either lake.